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ABSTRACT

Medical care is viewed as an investment good, as contrasted with a consumption good. Numerous studies are cited which support the overall contention that improved health affects productivity through its effects on a person's education. The number of school days lost and the number of school dropouts which result from poor health are considered in terms of the ultimate economic loss to the person and to the nation. The value of productivity losses is associated with reduced educational attainment. The authors encourage further efforts to separate the several relationships which they suggest. (TL)

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THE EFFECTS OF IMPROVED HEALTH ON PRODUCTIVITY THROUGH EDUCATION

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THE EFFECTS OF IMPROVED HEALTH ON PRODUCTIVITY THROUGH EDUCATION

Irving Leveson, Doris Ullman, and Gregory Wassall*

INTRODUCTION

Medical care is both a consumption good and an investment good. Economists have made a substantial number of studies of the consumption aspects in the area of the demand for medical care.(1) Investment aspects have only recently been considered as part of the growing interest in human capital and the emergence of health economics as a specialization.(2,3,4,5) While the extensive discussion of health as an investment by Selma Mushkin appeared in 1962,(6) there has been little followup to the many questions raised. A number of authors have produced estimates of the investment benefits of improved health. The most notable of these is the work of Dorothy Rice.(7,8) Extensive information now exists on the effect of improved health on the number of manhours worked and the value of the production gained. However, there has as yet been no satisfactory estimation of the effects of improved health on productivity.

Knowledge of the effects of health on productivity is important in determining the role of medical care in capital formation and the contribution of improvements in health to economic growth.(4,9,10) It will be increasingly useful in the future in untangling the two-way relationship between health and income. Omission of productivity effects in estimates of the value of improved health biases our thinking about resource allocation away from medical care toward other

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investments. It also makes us seriously understate the benefits of reduced morbidity relative to reduced mortality.

A major part of the effects of improved health on productivity occurs through the effects of health on education. This is especially important since much of the historical reduction in death rates has come at the youngest ages. Omission of the effects of health on education causes us to seriously understate the relative beneifts of child health programs in cost-beneift studies. Information on the effects of health on education is also useful in understanding the demand for both health and education, and particularly in separating out the effects of health on education in studies of the returns to education.

Health may affect the number of years of school completed by an individual, his absenteeism, his attentiveness while present in school, the time devoted to homework, etc., and through its effects on these may influence the rate of learning of both himself and his classmates. A one percent increase in time lost from school can potentially reduce long-run performance by several percent if a cumulative process of falling behind is initiated. Poor health requires that large amounts of resources be devoted to keeping a million and a half children in special schools and classes. Less formal education can impede access to vocational, education and on-the-job training, while the direct effect of poor health will be to make training efforts less successful. The benefits of greater education from improved health of children include not only increases in market production, but improvements in efficiency as a consumer, reductions in the social costs of dependency, performance as a voter, ability to serve in the armed forces, etc. Since the education of parents influences the education and aspirations of children, there may be important intergeneration effects on poverty.*

This paper considers the relationships between health status and educational attainment, achievement, and absenteeism. Earlier materials

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*Of course some of the relationship between education of parents and children could be due to the effects of health on the education of both.

An increase in education due to improved health could reduce crime. However, better health may increase the initiative or effectiveness of criminals as well.

on absenteeism, school dropouts, and armed forces rejectees are examined, and new data from a study of school health records and armed forces rejection are presented. Some rough overall calculations are made of the effects of health on productivity through education.

EARLIER INFORMATION ON HEALTH AND EDUCATION

Chronic Conditions

Existing data have indicated that the presence of chronic conditions among children is very low. In 1959, only 33,000 children age 6-16 were found to have chronic conditions by the National Health Survey.(11) However, recently, the Social Security Administration has found that methodological improvements doubled the number of non-institutionalized adults under age 65, reporting chronic conditions.(12) A similar understatement may exist for children as well.

School Loss Days

Children age 6-16 in the civilian non-institutional population had 220 million school loss days in 1966. The figure would undoubtedly be substantially higher if time loss by older students and persons in hospitals was included. The extent to which full days of school were lost by children aged 6-16 by reason of injury or illness are compared with work loss days of persons aged 17 or more in Table 1. Table 2 provides detail by diagnostic category for activity loss due to acute conditions. While the number of school loss days per person is somewhat lower than the number of work loss days, the school year is shorter, so that a day of school lost actually consumes a higher proportion of the time devoted to that activity. In both cases, differences between sexes are not large. Respiratory and infectious diseases are relatively more common causes of school loss days while injuries are a substantial factor in work loss. Greater detail on reasons for school loss can be found elsewhere.(13)

Some related evidence comes from a study of the effect of housing on health. In a comparison of days of attendance at school of children

Table 1

LOSS OF ACTIVITY DAYS BY SEX, 1966
(Days per person per year)

	Total	Male	Female
School loss days per year per person age 6-16	5.2	5.1	5.3
Work loss days per year per person age 17 or more	5.8	5.9	5.6

Source: U.S. Bureau of the Census, Statistical Abstract of the United States, 1967, Washington: 1967, Table 109.

Table 2

LOSS OF ACTIVITY DAYS FOR ACUTE CONDITIONS BY CAUSE, 1966
(Days per 100 persons per year)

Diagnostic Category	School Loss	Work Loss
Infective and parasitic	102	29
Respiratory	288	164
Digestive	12	17
Injuries	25	121
All Other	26	39

Source: U.S. Bureau of the Census, Statistical Abstract of the United States, Washington: 1967, Table 108.

before and after relocation into better housing with attendance in a control group, Wilson et al., found relative improvements in attendance for the test group in conjunction with decreases in the number of disability days.(14)

Dropouts

Over the years there have been a number of studies indicating that about 5-7 percent of persons dropping out of school have done so primarily because of illness (excluding maternity). While multiple causes are undoubtedly often present, these studies are not likely to overstate the effect of health on dropping out. First, while other causes may contribute to dropping out by students citing health as the major reason, health probably contributes in many cases where other causes are cited. Furthermore, the possibilities for understating the effects of mental health are great. Some studies are cited below.

A study by Harold Dillon of dropouts in five midwestern counties found five percent citing ill health.(15) A Department of Labor survey of school and employment experiences of high school youths in seven communities found that according to interviews, health was cited by 5 percent males and 7 percent of females, while school records showed figures of 4 and 9 percent respectively.(16) A Department of Health, Education and Welfare study of dropouts found in interviews in seven areas, that 5 percent of males and 7 percent of females dropping out of school cited health reasons.(17) The Department of Labor has used its regular household interviews to make national estimates. These are shown in Table 3. The reader is cautioned that the sampling variability of the estimates is large. As in other surveys, health is more frequently cited by women than men.

No data is available on specific conditions of health from the studies of dropouts. A recent study of psychiatric admissions to Bronx State Hospital found that relative to the community, a disproportionate number of patients were high school and college dropouts.(18)

Table 3

PERSONS AGE 16-21 DOPPPING OUT OR LEAVING SCHOOL
GIVING MAIN REASON AS OWN ILLNESS
(Percentage, level of school, sex, and color)

Education	Male	Female	Total
Elementary or High School:			
White	3.5	6.9	5.4
Non-white	6.0	5.8	5.8
Total	4.0	6.6	5.5
College: Total	2.5	8.2	5.8

Source: U.S. Bureau of Labor Statistics, Out of School Youth, February, 1963, Special Labor Force Report No. 46, Table A-6.

Armed Forces Rejectees

Studies of reasons for armed forces rejection provide useful information about health status as determined in comprehensive physical examinations. Comparisons of educational attainment of persons with various diagnoses may not demonstrate conclusive casuality regarding the effects of health on education, but they can nevertheless provide useful insights. The New York City Department of Health undertook a referral program for 12,000 rejectees which generated such data.(19) This source does not indicate how education differs among more or less healthy populations. However, it does serve to indicate the relative importance of various diagnoses. The findings are summarized in Table 4. Only whites are shown in order to partially remove effects of other factors on the relationship. The data on causes of rejection have their accuracy limited by the presence of multiple causes, but they are nevertheless suggestive. The relative importance of certain psychological disorders and eye and ear diseases and defects are apparent.

Table 4

EDUCATION OF WHITE ARMED FORCES MEDICAL REJECTEES
(By Reason for rejection, October 1962-September 1964)

Disqualifying Diagnosis	Education: Less Than 12 years (percent)	12 years (percent)	More Than 12 years (percent)	Total (percent)	Number of Persons With Known Education
Psychiactric, other than sexual deviation and narcotic addiction	17.8	14.6	67.6	100.0	3,194
Inadequate personality	51.9	23.2	24.9	100.0	297
Scizoid personality	16.9	23.5	59.6	100.0	272
Anxiety reaction	15.9	24.4	59.8	100.0	656
Schizophrenic reaction	25.6	18.8	55.6	100.0	223
Other	11.9	7.5	80.6	100.0	1,746
Physical diseases and defects	24.0	32.4	43.6	100.0	5,388
Bones and organs of movement	23.6	30.8	45.6	100.0	1,251
Eye	26.7	30.9	42.5	100.0	1,133
Circulatory system	22.8	33.3	43.9	100.0	973
Ear and mastoid process	30.3	39.0	30.8	100.0	413
Nervous system	19.7	31.7	48.6	100.0	315
Allergic disorders	9.1	28.3	62.5	100.0	307
Albuminuria	41.5	36.3	22.2	100.0	212
Digestic system	17.3	27.7	55.0	100.0	191
Other	23.3	35.1	41.6	100.0	592

Source: Jules E. Vandow, et al., "Health Referral Services for Armed Forces Rejectees," Public Health Reports, 82, No. 4, April 1967, pp. 305-322, Table 3.

The effects of health problems on achievement during a given number of years of schooling will be to increase the mental rejection rate. Available data do not permit us to estimate this effect.

SOME NEW INFORMATION

The New York City Department of Health has been conducting a study to determine the feasibility of identifying potential selective service medical rejectees from school health records.[20] The study chose a stratified sample of 3,511 males in the 8th and 9th grades in 1954-1955 for whom selective service records could be obtained by 1966. To some extent the school health data is more valuable than the armed forces medical examinations. The latter is only available for medical rejectees and the priority with which administrative, mental, and medical rejection are recorded for persons who would be rejected for more than one reason is not clear.

The school records suggest a variety of relationships between health and education, assuming that we are not simply observing the effects of other socio-economic factors. Only 63.0 percent of persons with reported psychological problems who began high school completed it, compared to 74.2 percent for those without such problems noted in the records. This presumably reflects the adverse effects of health on education, although control for other variables and examination of interaction effects is needed before firm conclusions can be drawn.* On the other hand, persons with orthopedic difficulties showed a 74.5 percent graduation rate compared to 69.3 percent for all examinees. It is possible that more limited employment and athletic alternatives induced this group to continue their education longer. A third relationship is that of education on health. Among those persons with vision defects, as many as 78.0 percent completed high school. A

*There are indications in this data and other studies that interaction effects among multiple medical problems and between medical and other problems may be very important. Poor health may give an individual justification for reacting to other problems by less productive behavior.

similar pattern is found for reading level. In this case education may work adversely. Graduation rates for examinees with selected health problems are compared in Table 5.

Educational attainment by armed forces examination status is shown in Table 6. There is uncertainty as to how often multiple causes are shown. Since we need to compare groups comparably screened for mental abilities, the most appropriate comparisons are between all medical rejectees and all examinees, and between persons rejected for medical reasons only and acceptees. The pattern observed is greater educational attainment for the medical rejectees. This may occur because the more educated are more aware of their health problems as a result of having received more medical care or of receipt of greater knowledge generally. They may also be aware of possible causes for medical rejection and bring such problems to the attention of the examining physician.

The situation with respect to achievement as measured by math and reading levels is quite different. Table 7 reveals that medical rejectees have substantially higher math and reading levels than all examinees. However, persons rejected for medical reasons only are more often found with both the highest and lowest math and reading levels, a factor which may be the result of the multiplicity of relationships suggested by the data on specific problems.

THE VALUE OF PRODUCTIVITY LOSSES ASSOCIATED WITH REDUCED EDUCATIONAL ATTAINMENT

It is possible to make rough estimates of the net effects of positive and negative influences of health on education. First, we make use of data in Table 3 to calculate the effects of health on educational attainment. Earnings of the current labor force will depend on past education. We assume that the proportion of persons dropping out because of health was the same in previous years as in 1963. We then estimate a hypothetical distribution of the current labor force by years of formal education completed, that would have prevailed if no one had discontinued education because of poor health.

Table 5

GRADUATION RATES OF PERSONS WITH SELECTED DEFECTS ON SCHOOL HEALTH RECORDS, COMPARED TO ARMED FORCES EXAMINEES AND MEDICAL REJECTEES

	Percentage Graduating High School
Examinees	69.3
Medical Rejectees	74.5
Persons with:	
Speech defect	72.6
Bad uncorrected vision	78.0
Emotional disturbance:	
Shyness	70.6
Immaturity	71.8
Nervousness	70.5
Heart murmur	63.6
Asthma	73.9
Injuries of limbs	74.8

Source: Sample data from study of Densen, Ullman, and Vandow.

Table 6

EDUCATION OF ARMED FORCES MEDICAL REJECTEES AND ALL EXAMINEES
(Given in percentages)

Years of School Completed	All Examinees	Acceptees	Medical Rejectees		
			All	Medical Only	Medical and Other
8	2.9	1.5*	2.9*	1.4*	16.7*
9	8.0	5.3	5.5*	4.8*	11.7*
10	10.7	8.9	8.1	7.5*	13.3*
11	9.2	8.9	9.0	8.2*	16.7*
12	69.3	75.5	74.5	78.0	41.7*
Total	100.0	100.0	100.0	100.0	100.0

*Fewer than fifty observations.

Source: Sample data from study of Densen, Ullman and Vandow.

Table 7

MATH AND READING LEVELS OF ARMED FORCES MEDICAL REJECTEES AND ALL EXAMINEES
(Given in percentages)

			Medical Rejectees		
Math	All Examinees	Acceptees	All	Medical Only	Medical and Other
3 or more years behind	19.4	19.4	30.1	15.8	52.1*
1-3 years behind	27.6	28.4	25.9	24.9	22.9*
less than 1 year behind or ahead	22.9	24.8	18.6	23.0	10.4*
1 or more years ahead	30.1	32.3	25.4	36.3	14.6*
Total	100.0	100.0	100.0	100.0	100.0
Reading					
3 or more years behind	18.9	13.2	31.2	16.2	50.0*
1-3 years behind	24.2	24.7	23.2	23.1	22.0*
less than 1 year behind or ahead	31.9	35.7	23.9	30.6	14.0*
1 or more years ahead	25.0	26.5	21.8	30.1	16.0*
Total	100.0	100.0	100.0	100.0	100.0

*Sample size less than 50.
Note: Excludes persons with information shown not known.
Source: Sample data from study of Densen, Ullman and Vandow.

We may seriously underestimate this effect if health was poorer in earlier years. The results of this calculation are shown by sex for the labor force of March 1966, in Table 8.*

It would be useful to determine the amount by which the Gross National Product would currently be greater if the education of the present labor force had not been impeded by poor health. Using data on earnings by education, it is neither possible to get a separate estimate of the effect of health on earnings through educational attainment or to get complete total of the effects through attainment, achievement, absenteeism, and vocational and on-the-job training. For example, the direct effects of achievement and its impact on subsequent training opportunities are included along with the effects of educational attainment in comparisons of earnings of persons having greater education with earnings of others. Nevertheless, we can get a minimum estimate of the overall effects.

Combining data on the variation in earnings with education and estimates of the effects of health on education, the reduction in the value of output due to ill health can be estimated. Average hourly and annual earnings of non-farm employed persons in 1959 are shown in Table 9. Non-farm earnings are used because data for agriculture excludes income in kind and may be subject to serious underreporting. This will produce a slight understatement of the estimates. Using the distributions in Table 3 we estimate that the effects of health on hourly earnings was .8 percent for males and 1.7 percent for females. Using annual earnings to include the effects of unemployment and underemployment produces estimates of 1.1 percent and 1.7 percent respectively. Labor income (compensation of employees plus 80 percent of proprietors' income) was $517 billion in 1967. About four-fifths of it was earned by men. Using this information, the estimates imply a loss of $5 billion based in hourly earnings and $6 billion based on annual earnings.

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*It is assumed that the probability of completing any succeeding grade of a person had dropped out due to health is the same as for those who remained in school. For each grade level and sex, the number of persons who would not have dropped out was computed. This was deducted from the completed grade level and distributed among higher levels.

Table 8

DISTRIBUTION OF PERSONS IN THE LABOR FORCE IN MARCH 1966
ASSUMING NO ILLNESS
(Given in percentage, years of school completed, sex, actual and estimated)

Years of School Completed	Male		Female	
	Actual	Estimated	Actual	Estimated
0-4	4.0	3.8	2.0	1.9
5-8	20.6	19.9	15.7	14.8
9-11	19.3	18.8	18.4	17.5
12	32.6	32.2	43.0	41.8
13-15	10.7	11.3	11.0	12.0
16 and over	12.8	14.0	9.9	12.0
Total	100.0	100.0	100.0	100.0

Note: It is assumed that a person dropping out of school because of illness would have had the same probability of reaching a higher grade as a person who remained in school, if not for the illness.

Source: U.S. Bureau of Labor Statistics, Educational Attainment of Workers, March 1966, Special Labor Force Report No. 83, Washington, 1967, Table B, and Out-of-School Youth, February 1963, Special Labor Force Report No. 46, Table A-6.

Table 9

AVERAGE HOURLY AND ANNUAL EARNINGS OF NON-FARM EMPLOYED PERSONS BY YEARS OF SCHOOL COMPLETED AND SEX, 1959

Years of School Completed	Average Hourly Earnings Male	Female	Average Annual Earnings Male	Female
0-4	$1.80	$1.09	$3,278	$1,605
5-8	2.32	1.32	4,471	1.977
9-11	2.52	1.53	4,857	2,211
12	2.72	1.72	5,752	2,748
13-15	3.28	1.99	6.763	3,014
16 and over	4.27	2.75	9,324	4,211
Total	$2.79	$1.70	$5,607	$2,593

Source: Victor R. Fuchs, Differentials in Hourly Earnings by Region and City Size, 1959 (occasional Paper No. 101) New York: National Bureau of Economic Research, 1967.

In addition to including the return to the efforts of students which are made possible by improved health, earnings differences include returns to resources of the educational system which would be used productivity elsewhere if the education were not undertaken. Becker[2] estimated that one-fourth of the cost of college education in 1939 was composed of direct costs and three-fourths represented foregone earnings of students. If we apply this ratio currently, even assuming that persons below the college level have no foregone earnings would imply that foregone earnings make up half the costs of all education. Assuming college students have ten times the foregone earnings of elementary and secondary school pupils would increase the importance of foregone earnings in all education to two-thirds. It would therefore seem reasonable that a minimum estimate of productivity losses through dropping out of school for health reasons is $3 - $4 billion for employed persons.

We can get additional notions about the effect of absenteeism from the data on school loss days in Table 1. The average number of school loss days of 5.2 represented 3 percent of the school year. Loss of a school day may not have as large an effect on productivity as a proportional loss of a school year, so we will assume this is equivalent to a loss of 2 percent in educational attainment. If only one-fifth of the returns to labor in the economy could be attributed to education, this would imply a loss of output due to school loss of $2 billion. Some portion of this is not included in the estimated effects of educational attainment. Addition of losses due to days of poor school performance and any cumulative falling behind in school would greatly increase these estimates.

CONCLUSIONS

We have made only minimum estimates of the effects of health on educational attainment, achievement, absenteeism, and vocational and on-the-job training. More complete estimates could be considerably

larger. Inclusion of costs of special education for children with health problems may greatly enlarge the estimates. It is also necessary to include the costs of reduced education on a person's performance as a consumer, voter, etc.

Dorothy Rice has estimated morbidity losses in the total population at $21 billion in 1963.(7) A current figure would be about $25 billion. This includes the value of production lost through disability of persons out of the labor force, days lost from work by employed persons, and the value of housework lost. She assumed that persons who were unable to work would produce at the average level of employed persons if they were able to work. Inclusion of productivity losses from health would obviously raise this estimate substantially. The present estimates of that part of productivity effects which operate through education would raise Rice's estimate of morbidity losses by about one-fifth. The very minimal estimate of perhaps $5 billion of productivity losses through education compares with Rice's estimate of only 1 billion for the morbidity losses of persons under age 25. Prevention of these losses would result in a much larger stock of human capital--perhaps by as much as $50 billion.

Further research on the effects of health on productivity would be helpful for problems of resource allocation and capital formation. Much more work could be done on specific medical conditions as well as on other components of productivity loss. It would be useful for further efforts to attempt to separate the several relationships suggested--adverse effects of health on education, increased education because of limited alternative opportunities for the less healthy, and the positive and negative effects of education on health.

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